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Response to UK Department for Business, Energy and Industrial Strategy consultation: Building our Industrial Strategy

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1 Identification

Professor Stuart Haszeldine (OBE, FRSE) is Professor of Carbon Capture and Storage at the University of Edinburgh and director of Scottish Carbon Capture and Storage (SCCS).

SCCS is a research partnership of British Geological Survey, Heriot-Watt University, University of Aberdeen, the University of Edinburgh and the University of Strathclyde. SCCS researchers are engaged in high-level research and joint projects with industry to support the development and commercialisation of carbon capture and storage as a climate mitigation technology.

2 Context

Scottish Carbon Capture & Storage (SCCS) welcomes the opportunity to provide input and comment to the Department for Business, Energy and Industrial Strategy on the UK Industrial Strategy Green paper.

Carbon Capture and Storage (CCS) has been assessed multiple times, including by the UK Committee on Climate Change in its recent Fifth Carbon Budget advice, as a crucial means of underpinning economy-wide decarbonisation at least cost. CCS decarbonises fossil fuel power generation, is the only available method to address industrial emissions, and can enable the production of hydrogen as a low carbon vector for heating, energy storage and transport. Further, CCS in combination with biomass may potentially provide net-negative emissions to offset emissions which are too complex or expensive to directly mitigate. In the absence of CCS, full decarbonisation of power generation, heating and transport consistent with the UK's Climate Change Act 2008, and the recently agreed ambition for net-zero emissions in the UNFCCC Paris Agreement which UK ministers have endorsed, will likely be both extremely difficult and costly to achieve¹.

The UK has unique and substantial strategic advantages in CCS. These include:

- Excellent geological resources for CO₂ storage in the North Sea basin.
- Large and mature offshore hydrocarbon industry with skills and experience directly applicable to CCS delivery.
- Existing onshore and offshore hydrocarbon pipeline infrastructure appropriate and available for conversion to use for CO₂ collection and transport to offshore storage.

¹ A strategic approach to carbon capture and storage (UK CCC letter to DECC Secretary of State, 2016)
<https://www.theccc.org.uk/wp-content/uploads/2016/07/Letter-to-Rt-Hon-Amber-Rudd-CCS.pdf>

- Successful industrial clusters located accessibly to pipeline and/or port connections to North Sea CO₂ storage opportunities².
- Potential for CO₂-enhanced hydrocarbon recovery in North Sea oil fields to achieve both CO₂ removal, and additional hydrocarbon production extending recovery and income from the North Sea³.
- World-leading academic and industrial research into CCS technologies – CO₂ capture, CO₂ transport and CO₂ storage.

These strategic advantages have been developed through sustained UK investment in CCS research and development, totalling in excess of £200 million investment over a period of more than a decade⁴.

The premature cancellation of the BEIS predecessor Department for Energy and Climate Change CCS Commercialisation programme was a substantial set-back to UK CCS development. However, the need and strategic advantages for CCS in the UK remain, and present a near-term opportunity for successful and profitable UK industrial development fulfilling the objectives of the ‘ten pillars’ of the proposed Industrial Strategy. As such, it is extraordinary that CCS appears absent from the Industrial Strategy Green paper, and BEIS is strongly urged to assess its omission. CCS is much more than just lower carbon electricity, and UK all-energy and industry decarbonisation require solutions beyond renewables.

3 Consultation question responses

Question 1: *Does this document identity the right areas of focus: extending our strengths; closing the gaps; and making the UK one of the most competitive places to start or grow a business?*

The overall vision of building on the UK’s existing industrial strengths and advantages is supported. Here, it is contended that the UK Industrial Strategy should make strong consideration of the considerable UK industrial, skills and natural resources applicable to CCS, the benefits to these sectors of developing and growing the CCS sector, and the economy wide benefits of CCS deployment in achieving decarbonisation at lowest cost to both business and consumers⁵.

Question 2: *Are the ten pillars suggested the right ones to tackle low productivity and unbalanced growth? If not, which areas are missing?*

CCS strongly aligns with the proposed ten pillars. In particular CCS directly supports Pillar 7 ‘delivering affordable energy and clean growth’ both through delivering the lowest cost decarbonisation pathway, and through the domestic development of the sector securing economic benefit by building on existing successful sectors – not least the major UK subsurface and offshore industries. This also fulfils Pillar 8 ‘building [sectors] on our areas of competitive advantage’, and Pillar 9 to ‘build on particular strengths of different places’. The UK is also a

² A new industrial future for the UK (Teesside Collective, 2015)
<http://www.teessidecollective.co.uk/>

³ CO₂ storage and Enhanced Oil Recovery in the North Sea: Securing a low-carbon future for the UK (SCCS, 2015)
<http://www.sccs.org.uk/images/expertise/reports/co2-eor-jip/SCCS-CO2-EOR-JIP-Report-SUMMARY.pdf>

⁴ Carbon Capture and Storage: the second competition for government support (National Audit Office, 2017)
<https://www.nao.org.uk/report/carbon-capture-and-storage-the-second-competition-for-government-support/>

⁵ Lowest Cost Decarbonisation for the UK: The Critical Role of CCS (Parliamentary Advisory Group on CCS, September 2016).
<http://www.ccsassociation.org/news-and-events/reports-and-publications/parliamentary-advisory-group-on-ccs-report/>

world-leading centre of CCS research which in line with Pillar 1 is a significant opportunity to 'commercialise our world leading science base to drive growth'.

Question 4: *Are there important lessons we can learn from the industrial policies of other countries which are not reflected in these ten pillars?*

How CCS fits with Pillars 1, 7 and 8 is discussed above. Here, example is given of the successful industrial policies on CCS in Norway to which the UK is currently losing advantage, and in doing so is ceding financial, innovation and industrial benefits worth multiple billions £GBP.

To deliver European climate mitigation objectives requires the development of CCS into an offshore industry comparable to hydrocarbons, but longer-lived. Developing an offshore storage industry for CO₂ derived from CCS includes all of: the financially very substantial (GDP increase of £5-10 Billion per year), long duration (multiple decades), and essential (to deliver EU and national emissions reduction targets) underpinning for future supply chains of sustainable carbon use in the UK and geographically neighbouring Europe.

Norway has supported CCS in operation since 1996 when the offshore storage of the CO₂ co-produced with methane from Statoil's Sleipner gas field commenced. The lessons to learn are that this far-sighted and durable cross-party government support has enabled confident growth of a substantial CCS ecosystem, comprising research in Universities (Norwegian University of Science and Technology), engineering consultancies (SINTEF), innovative engineering design and manufacture (Aker Solutions), shipping (Knutsen OAS Shipping and Larvik Shipping), and supporting multiple Norwegian primary industries (Statoil, Yara, Norcem). This CCS industry is now moving to design and construction of an operating system for CO₂ capture, transport and offshore storage at industrial scale. This comprises CO₂ capture from multiple sources with collection by ship, these delivering to an onshore facility which injects CO₂ into offshore storage via pipeline. This system is intended to begin operation by 2022 and is being designed to enable expansion.

Crucially for the UK to learn, are that these infrastructure developments have been led and financed by the state-owned companies Gassnova and Gassco. These state companies are tasked with reducing commercial risk between partners, as well as being themselves technically excellent. In contrast, the proposed UK approach of competitively contracting private market actors to develop CCS has now failed three times in succession to deliver.

Further, Norway's CCS infrastructure development has a clear strategy to create a pathway to growth through ship import of CO₂ from other emission sources around the North Sea especially the Netherlands, and via Rotterdam port inland Europe, and perhaps also the Teesside region of the UK. Once the shipping facilities and pipeline connections are built, then the directions of transport to storage of CO₂ are hard to shift. The UK, having spent hundreds of millions of £GBP on CCS development since 2005, has in 2015 pulled back from innovation at exactly the most crucial time enabling a competitor to take a commanding and long-term commercial advantage. Failing rapid action the UK industries may end up paying service charges to Norway for CO₂ disposal for many decades which while achieving climate objectives will achieve minimal UK value creation from a chain of skills and supply.

UK insistence on market led infrastructure development has failed for CCS. If the UK is to create a new CCS industry, and maintain the ability for competitive use of low cost carbon feedstocks into industrial, heat, power and transport sectors – then lessons for successful state intervention can be learned and applied from European neighbours. In assessing UK CCS options following

the CCS Commercialisation Programme cancellation the 2016 Oxburgh report sets out how this approach of temporary UK-state nurture can be applied to deliver a successful and profitable UK CCS industry⁶.

Question 5: *What should be the priority areas for science, research and innovation investment?*

Due to sustained investment, UK research is a world-leader in CCS, with strong collaboration with industry both in the UK and internationally. This research base should continue to be prioritised to support the commercialisation of this investment and realise the potential of the UKs' science, industry, skills and resources assets in line with the objectives of Pillar 1.

Question 14: *How can we enable and encourage people to retrain and upskill throughout their working lives, particularly in places where industries are changing or declining? Are there particular sectors where this could be appropriate?*

The UK has considerable workforce in offshore hydrocarbon production and services, a sector with declining UK production that is facing an immediately uncertain future. This workforce is regionally concentrated with limited options for re-deployment in the general economy. CCS is a unique growth opportunity for making use of these skills and giving a long-term future to the UK offshore and subsurface sectors. Additionally, UK energy intensive industries face a difficult future due to the imperative for decarbonisation. CCS provides a decarbonisation pathway for industrial emitters thereby retaining and advancing the 800,000 UK jobs in this sector and incentivising new investment⁷.

Question 15: *Are there further actions we could take to support private investment in infrastructure?*

The UK has unique assets in its existing infrastructure of onshore and offshore pipelines appropriate and available for conversion for CCS. Government should urgently and strategically secure these from decommissioning to enable low-cost investment in their re-use for CCS.

CCS opportunities in the UK are clustered in major industrial regions such as Teesside⁸ and Central Scotland⁹. Both these have developed CCS infrastructure concepts sharing CO₂ transport infrastructure to enable low-cost CCS deployment. The UK government urgently needs to bring forward policy to support industry CCS to build investor confidence and provide a pathway to the realisation of these, and other UK CCS clusters, thereby enabling industry futures compatible with the imperative for decarbonisation.

Lastly, there is growing interest in the conversion of UK gas networks to hydrogen to decarbonise heating. The Leeds City Gate H21 report favourably assesses this opportunity to cost-effectively decarbonise heat and continue the use of the high-value methane distribution network¹⁰. Hydrogen is supplied at lowest cost through steam-methane-reforming (SMR) of natural gas with CO₂ capture, or through very high temperature coal gasification in a closed system with CO₂ capture. Hydrogen production by SMR with CCS is commercially operational and demonstrated in facilities in the US and Japan. As part of its forthcoming Clean Growth

⁶ Lowest Cost Decarbonisation for the UK: The Critical Role of CCS (Parliamentary Advisory Group on CCS, September 2016). <http://www.ccsassociation.org/news-and-events/reports-and-publications/parliamentary-advisory-group-on-ccs-report/>

⁷ The economic benefits of carbon capture and storage in the UK (TUC and CCSA, February 2014) <https://www.tuc.org.uk/sites/default/files/carboncapturebenefits.pdf>

⁸ A business case for a UK Industrial CCS support mechanism (Teesside Collective, 2017)

<http://www.teessidecollective.co.uk/teesside-collective-report-a-business-case-for-a-uk-industrial-ccs-support-mechanism/>

⁹ Scottish CO₂ Hub, a unique opportunity for the UK (SCCS, 2016) <http://www.sccs.org.uk/images/expertise/reports/working-papers/wp-2016-01.pdf>

¹⁰ H21 Leeds City Gate (Northern Gas Networks, 2016) <http://www.northerngasnetworks.co.uk/archives/document/h21-leeds-city-gate>

Plan the UK government should consider and assess policy to support the development and investment into hydrogen infrastructure as a low-carbon energy vector.

Question 16: *How can local infrastructure needs be incorporated within national UK infrastructure policy most effectively?*

Please see response to question 15 above.

Question 22: *What are the barriers faced by those businesses that have the potential to scale-up and achieve greater growth, and how can we address these barriers? Where are the outstanding examples of business networks for fast growing firms which we could learn from or spread?*

Due to the UK's superb combination of industrial, skill and resource assets and substantial (£200+ million) prior investment the UK CCS sector has great potential to rapidly scale-up. Set against that, investor confidence was severely damaged by the un-consulted cancellation of the DECC CCS Commercialisation Programme (2015) and before that the DECC CCS Competition (2011). To rebuild investor confidence the Industrial Strategy should link to the forthcoming Clean Growth Plan in presenting clear objectives and policies to support the development of CCS. These should not focus narrowly on the power sector, but also recognise the importance of timely CCS development for the decarbonisation and preservation of energy-intensive industry, and the potential role of CCS as a route to hydrogen for tackling the challenges of heat decarbonisation, inter-seasonal energy storage, and transport.

Question 27: *What are the most important steps the Government should take to limit energy costs over the long-term?*

The deployment of CCS is consistently shown to be critical to achieving decarbonisation at the lowest cost to businesses and consumers. Energy Technology Institute analyses find that delays to CCS deployment in the 2020s might cost consumers £1-2 billion per year and negatively impact energy intensive industries. Longer-term, they estimate a cost increase of £32 billion per year in the absence of CCS to achieve the UK's 80% by 2050 emissions reduction objectives¹¹. These findings are supported by UK Committee on Climate Change evidence for the UK fifth carbon budget¹².

The decarbonisation of heat presents a further substantial challenge. Re-purposing existing methane networks to hydrogen produced via steam methane reforming with CCS presents a low-cost and minimally disruptive opportunity to addressing seasonal heat demand¹³.

To limit energy costs, Government should therefore urgently clarify its position on CCS and present policies aligned between the Industrial Strategy and Clean Growth Plan intended to support its timely delivery.

Question 29: *How can the Government, business and researchers work together to develop the competitive opportunities from innovation in energy and our existing industrial strengths?*

As outlined in the introduction, the UK has significant competitive opportunities in CCS. These include world-leading research, regional clusters of emissions sources accessible to North Sea

¹¹ Building the UK CCS sector by 2030 – Scenarios and actions (ETI, 2015) <http://www.eti.co.uk/insights/carbon-capture-and-storage-building-the-uk-carbon-capture-and-storage-sector-by-2030/>

¹² Power sector scenarios for the fifth carbon budget (CCC, 2015) <https://www.theccc.org.uk/publication/power-sector-scenarios-for-the-fifth-carbon-budget/>

¹³ H21 Leeds City Gate (Northern Gas Networks, 2016) <http://www.northerngasnetworks.co.uk/archives/document/h21-leeds-city-gate>

CO₂ storage, and infrastructures, industries and skills applicable to delivering CO₂ transport and making use and revenue from the UK's substantial geological CO₂ storage opportunities. Through CCS programme investment and the Office for CCS, UK government has previously supported excellent collaboration across these opportunities towards the realisation of CCS for the UK leading to strong and deliverable CCS project proposals. There has frequently been excellent engagement of University research co-design of CCS projects with industry and government – for example through Innovate UK to individual Universities or through networks such as SCCS, the UK CCS Research Centre, and British Geological Survey.

Government should seek to repair the damage of the premature cancellation of the CCS Commercialisation Programme and rapidly rebuild collaboration by clarifying its position on the future role of CCS in the UK. It should then act to operationalise established and known input from research and industry stakeholders in the development of policies for CCS delivery. That will build upon and learn from the considerable investment and learning in the UK CCS programmes to date. Here, it is suggested that government should broaden engagement on CCS and its role across sectors, in particular towards energy intensive industries and heat decarbonisation. These present opportunities for lower cost and reduced complexity CCS development than the previous focus on a rapidly changing power sector.

Question 31: *How can the Government and industry help sectors come together to identify the opportunities for a 'sector deal' to address – especially where industries are fragmented or not well defined?*

Following on from response to question 29, it is suggested that government should create a 'Sector Deal' on CCS to broaden engagement across the many sectors where CCS can bring benefit and growth. Here, government might usefully build on existing successful research and industrial collaborations, and through providing clarity on the envisaged role of CCS in the UK support the building of regional partnerships linking end-user demand for low-carbon energy or emissions clean-up with suppliers of CO₂ takeaway and storage services.

Question 33: *How can the Government and industry collaborate to enable growth in new sectors of the future that emerge around new technologies and new business models?*

CCS is a critical and strategic future sector and opportunity for the UK. As part of CCS partnerships and collaborations the CCS industry has developed ideas for new business models to deliver CCS across sectors and at lower costs than those that resulted from previous UK programmes¹⁴ ¹⁵. Similarly, there is substantial opportunity to build upon the UK's research strength in CCS and in learning-by-doing developing new technologies and services both for the UK market and export. However, for both these, industry requires clarity in government objectives for the CCS sector and confidence in government support towards the delivery of these objectives. Here, the Industrial Strategy and forthcoming Clean Growth Plan are a crucial opportunity to re-establish government and industry CCS collaboration and put CCS back onto a pathway to delivery in and for the UK.

¹⁴ A business case for a UK Industrial CCS support mechanism (Teesside Collective, 2017).

<http://www.teessidecollective.co.uk/teesside-collective-report-a-business-case-for-a-uk-industrial-ccs-support-mechanism/>

¹⁵ Lowest Cost Decarbonisation for the UK: The Critical Role of CCS (Parliamentary Advisory Group on CCS, September 2016).
<http://www.ccsassociation.org/news-and-events/reports-and-publications/parliamentary-advisory-group-on-ccs-report/>